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### P43: MASKED HYPERTENSION AND RETINAL VESSEL STRUCTURE AND FUNCTION IN YOUNG HEALTHY ADULTS: THE AFRICAN-PREDICT STUDY

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historical and contemporaneous values of PP and MAP as well as age and heart rate, PWV was significantly associated with  $PP_C$ ,  $MAP_C$  and  $PP_H$  but not with  $MAP_H$ . In the sub-study in which historical values of PWV were available, PWV increased by  $0.75 \pm 1.42$  m/s, over an average of  $5.5 \pm 1.7$  years. The change in PWV was associated with  $MAP_C$  and with  $PP_H$  ( $\beta = 0.144$ ,  $p < 0.001$ ).

**Conclusions:** These results are consistent with strong dependence of PWV on contemporaneous BP but also historical values of pulse pressure which may drive arterial stiffening.

### P38

#### DIFFERENCES IN FORM FACTOR CALCULATED FROM OSCILLOMETRIC OR WAVEFORM MEAN ARTERIAL PRESSURE

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**Background:** Oscillometric mean arterial pressure (MAP) agrees closely with invasive MAP, [1] but most devices do not report MAP and it is usually estimated by a form factor (FF). However, blood pressure (BP) measurement errors will affect FF, its correlations with exposures, and introduce errors into MAP estimated from the BP waveform.

**Methods:** Brachial BP was measured using a Pulsecor device in 1,112 participants in the Southall and Brent Revisited study ( $68.8 \pm 6.1$  y; 78.2% male; 47.4% White-European; 38.3% South-Asian; 14.3% African-Caribbean). Form factors (FFosc and FFwave) were calculated as ( $MAP$ -diastolic BP)/(systolic BP-diastolic BP) by oscillometry (MAPosc) or from the BP waveform (MAPwave).

**Results:** FFosc and FFwave differed ( $0.28$  ( $SD = 0.02$ ) vs.  $0.36$  ( $SD = 0.04$ );  $p < 0.001$ ) and were negligibly correlated ( $r = 0.07$ ). Neither FFosc nor FFwave were associated with ethnicity, prevalent cardiovascular disease or current smoking status, and neither showed significant correlations with age, total- or HDL-cholesterol, or physical activity. Both FF<sub>osc</sub> and FF<sub>wave</sub> were lower in men (difference ( $\Delta$ ) =  $-0.005$ (95% CI =  $-0.007$ ,  $-0.002$ ) vs  $-0.015$ (95% CI =  $-0.020$ ,  $0.009$ ) respectively) and were negatively correlated with height ( $r = -0.14$  both), but only FF<sub>wave</sub> correlated with body mass index ( $r = 0.02$  vs  $r = 0.10$ ) and heart rate ( $r = -0.06$  vs  $r = 0.20$ ).  $\Delta MAP_{osc}$ - $MAP_{wave}$  correlated with age ( $r = 0.10$ ), height ( $r = 0.15$ ) and heart rate ( $0.17$ ) and was greater in women ( $0.9$ (95% CI =  $0.5$ ,  $1.3$ ) mmHg).

**Conclusions:** FF<sub>wave</sub> agrees poorly with FF<sub>osc</sub> probably due to measurement errors. This creates spurious associations between exposures and FF and causes systematic errors in estimated MAP<sub>wave</sub>. These errors have the potential to confound associations in epidemiological studies.

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### P39

#### ACUTE RESPONSES OF PULSE WAVE REFLECTION AFTER AEROBIC EXERCISE WITH DIFFERENT VOLUMES

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**Background:** Although Aerobic Exercise (AE) has been recognized for lowering Blood Pressure (BP), little is known about the alterations in aortic BP after exercise (1,2). PURPOSE: To investigate the acute pulse wave reflection responses induced by AE with different volumes in normotensive and hypertensive men.

**Methods:** We included 12 normotensives [aged:  $38.3 \pm 10.1$  years, body mass index (BMI):  $25.9 \pm 3.6$  kg/m<sup>2</sup>, maximal oxygen uptake (VO<sub>2max</sub>):  $31.4 \pm 6.9$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, systolic/diastolic BP (SBP/DBP):  $121 \pm 6/74 \pm 4$  mmHg] and 7 hypertensive men [aged:  $39.1 \pm 6.0$  years, BMI:  $29.4 \pm 3.1$  kg/m<sup>2</sup>, VO<sub>2max</sub>:  $26.1 \pm 1.8$  mL·kg<sup>-1</sup>·min<sup>-1</sup>, SBP/DBP:  $140 \pm 8/88 \pm 7$  mmHg]. The participants were submitted to a maximal cardiopulmonary exercise test, a non-exercise control session (CTL), and two bouts of continuous cycling at 50% VO<sub>2</sub> reserve (150 vs. 300 kcal) in a randomized, counter-balanced order. Aortic systolic pressure, aortic pulse pressure, augmentation pressure, and augmentation index (Alx) were determined 10 min before and 70 min after the CTL and the two exercise bouts in a supine position by applanation tonometry (SphygmoCor v7).

**Results:** Central pressures and Alx were different between normotensive and hypertensive men after the two AE bouts as shown in table 1.

**Conclusion:** Although both AE were able to reduce pulse wave reflection in hypertensive men, only the major volume has attenuated the increase in central aortic BP observed in the control session.

Table 1: Mean  $\pm$  SD values for the pulse wave reflection indicators at baseline and post- CTL and AE bouts with 150 and 300 kcal.

Variables	Condition	Normotensive		Hypertensive	
		Baseline	Recovery	Baseline	Recovery
Aortic Systolic Pressure (mmHg)	CTL	99.83 $\pm$ 4.46	104.75 $\pm$ 7.81†	113.71 $\pm$ 14.52	124.86 $\pm$ 18.90†
	150 kcal	98.17 $\pm$ 6.21	99.08 $\pm$ 7.99	114.71 $\pm$ 11.14	124.43 $\pm$ 18.11*
	300 kcal	100.25 $\pm$ 5.34	100.00 $\pm$ 6.98	114.43 $\pm$ 15.14	119.57 $\pm$ 13.37
Aortic Pulse Pressure (mmHg)	CTL	29.67 $\pm$ 3.72	28.67 $\pm$ 4.25	30.57 $\pm$ 7.48	35.29 $\pm$ 9.30
	150 kcal	28.00 $\pm$ 3.54	27.83 $\pm$ 3.56	31.29 $\pm$ 3.90	33.71 $\pm$ 5.99
	300 kcal	30.08 $\pm$ 3.31	27.75 $\pm$ 4.04	31.14 $\pm$ 7.75	32.29 $\pm$ 4.64
Aortic Augmentation Pressure (mmHg)	CTL	4.83 $\pm$ 4.42	3.75 $\pm$ 3.51	3.43 $\pm$ 5.22	7.86 $\pm$ 5.52†
	150 kcal	3.67 $\pm$ 3.60	1.58 $\pm$ 3.60	4.57 $\pm$ 3.10	6.86 $\pm$ 5.52
	300 kcal	3.08 $\pm$ 4.33	1.83 $\pm$ 3.83	4.00 $\pm$ 6.13	5.43 $\pm$ 3.59
Augmentation Index (%)	CTL	13.33 $\pm$ 10.22	11.83 $\pm$ 12.34	10.43 $\pm$ 12.52	20.43 $\pm$ 10.81†
	300 kcal	9.50 $\pm$ 13.54	5.75 $\pm$ 12.48	10.14 $\pm$ 13.69	5.75 $\pm$ 12.48

\*: Significant difference compared baseline and recovery in the same condition, using paired t-test ( $P < 0.05$ )

†: Significant difference compared baseline and recovery in the same condition, using paired t-test ( $P < 0.01$ )

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### P41

#### INCREASED STIFFNESS IN THE DIGITAL ARTERIES OF ESSENTIAL HYPERTENSIVE WOMEN: THE FUCHSIA STUDY

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**Rationale and Aim:** Essential hypertension is characterized by extensive alterations of arterial geometry and mechanical properties: increased stiffness, dilation and wall of large arteries, increased thickness in muscular arteries, small artery remodeling. This study is aimed at exploring function and structure of the digital arteries of the hand, muscular arteries with an internal diameter of 500-1000 mm, easily accessible by ultrahigh frequency ultrasound.

**Methods:** 24 hypertensive women (HT) and 37 healthy controls (C) were recruited. 5'-videoclips of left palmar digital arteries were obtained by VevoMD (FUJIFILM, VisualSonics, Toronto, Canada), by means of a 70 MHz probe (axial-lateral resolution 30-65  $\mu$ m). An automatic system (Cvsuite, Quipu srl; Pisa, Italy) was used to measure intima-media thickness (IMT) and diameter. Distensibility and stiffness were then calculated using left brachial pulse pressure (PP - oscillometric)

**Results:** HT and C had similar age ( $57 \pm 11$  vs  $53 \pm 11$  years,  $p = 0.22$ ), BMI ( $24.9 \pm 4.6$  vs  $24.5 \pm 4.2$  vs  $kg/m^2$ ,  $p = 0.80$ ) and mean blood pressure (BP,  $95 \pm 12$  vs  $91 \pm 12$  mmHg,  $p = 0.24$ ); HT showed slightly higher PP ( $54 \pm 14$  vs  $47 \pm 10$ ,  $p = 0.07$ ). Palmar digital lumen tended to be higher in HT ( $804 \pm 201$  vs  $696 \pm 191$   $\mu$ m,  $p = 0.10$ ), while IMT was similar ( $120 \pm 23$  vs  $125 \pm 36$   $\mu$ m,  $p = 0.81$ ). Distensibility was reduced ( $21.4 \pm 18.2$  vs  $29.0 \pm 18.8$  kPa<sup>-1</sup>,  $p < 0.05$ ), while stiffness was increased ( $7.95 \pm 2.22$  vs  $6.72 \pm 2.11$  m/s,  $p < 0.005$ ).

**Conclusions:** This is the first report of the presence of altered mechanical properties (i.e. increased stiffness) in muscular arteries with lumen  $<1000$  mm of essential hypertensive women. These findings suggest that increased hemodynamic load characterizing hypertension lead to a different vascular phenotype in each arterial segment.

### P43

#### MASKED HYPERTENSION AND RETINAL VESSEL STRUCTURE AND FUNCTION IN YOUNG HEALTHY ADULTS: THE AFRICAN-PREDICT STUDY

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**Background:** Masked hypertension (MH) is prevalent in young adults and is associated with similar vascular complications as sustained hypertension, but whether this is already evident in young adults is unclear. We therefore compared retinal vessel calibres and function in response to flicker light induced provocation (FLIP) in young healthy adults stratified by MH status and explored associations between these parameters.

**Methods:** We used data from the first 566 participants (aged 20–30 years) taking part in the African-PREDICT study. Participants were clinically normotensive (70% valid readings) were measured and MH status determined. The central retinal artery (CRAE) and vein equivalent (CRVE) were calculated from fundus images and retinal vessel dilation responses to FLIP determined. **Results:** MH showed a prevalence of 16%. MHs' had a lower CRAE ( $155 \pm 10$  MU vs.  $160 \pm 12$  MU,  $p = 0.002$ ), but similar CRVE and vessel dilation in response to FLIP when compared to normotensives. The latter findings remained consistent upon adjustment for sex, ethnicity, age and body mass index. Multivariate regression analysis demonstrated an independent association between CRAE and the presence of MH ( $R^2 = 0.07$ ,  $\beta = -0.10$  (-0.20; -0.01)). No further associations existed between retinal vessel parameters and MH status.

**Conclusion:** Already at a young age, healthy adults with MH show slight adverse changes in the retinal microvasculature. Considering the prevalence of MH in young adults, and the predictive value of reduced CRAE, our data emphasize the early identification of altered 24 hr blood pressure patterns.

#### P45

#### IMPEDANCE CARDIOGRAPHY EVALUATION IN ELDERLY HYPERTENSIVE PATIENTS

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**Objectives:** Vascular aging results from endothelial dysfunction and increased arterial stiffness, a independent determinant of cardiovascular (CV) events, that is amplified by the presence and progression of arterial hypertension (AH). Age related changes in hemodynamic variables<sup>1</sup> may predict negative vascular outcomes.<sup>2</sup> In this study, we evaluate hemodynamic variables in elderly hypertensive patients with impedance cardiography (IC) in order to infer opportunities for therapeutic optimization.

**Methods:** We retrospectively analysed hypertensive patients that were proposed for IC evaluation. The selected 75 patients were divided into two groups, above or below 65 years old, matched by anthropometric and blood pressure (BP) values. (Table 1) Antihypertensive therapy wasn't considered. For each group the mean of IC variables was obtained, and statistical analysis was performed by a T-student test.

**Results:** From the patients included, 25 have  $\geq 65$  years and 50  $< 65$  years. In the elderly group mean age was 71 years, 52% were female and mean BMI 28,6 Kg/m<sup>2</sup>. Mean BP was 142 mmHg vs 135 mmHg for systolic and 74 mmHg vs 83 mmHg for diastolic BP, heart rate 63 bpm vs 69 bpm in elderly and younger group respectively. Mean IC results showed statistically significance differences for cardiac output, cardiac index, systemic compliance, left ventricular ejection time, velocity index and acceleration index between the groups. (Table 2)

**Conclusions:** BP determination and control may not signify adequate hemodynamic state. With this study, elderly hypertensive patients present different hemodynamic behaviour, compared with younger ones, in variables of blood flow, resistance and contractility. These data could have potential implications on the pharmacological optimization of BP treatment.

#### Poster session I – Models, methodologies and imaging technology I

#### P46

#### ELONGATION OF THE PROXIMAL AORTA DURING THE CARDIAC CYCLE PLAYS AN IMPORTANT ROLE IN THE ESTIMATION OF AORTIC COMPLIANCE

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**Background and Aims:** Arterial volume compliance is a major determinant of cardiac afterload. More than 50% of the arterial volume compliance resides in the proximal aorta. Researchers often use area compliance for the estimation of volume compliance, assuming an invariant vessel length over pressure changes. Recent studies have provided evidence to question this simplification, showing that the extension of the proximal aorta along its long axis during systole produces significant longitudinal strain, which could lead to erroneous estimation of arterial stiffness. The aim of the present study was to test this hypothesis in a computational environment.

**Methods:** The 3-D proximal aortic geometry of a healthy young male was reconstructed and meshed and the original zero-pressure geometry was restored. Material behavior was approximated based on the model of (1). Viscoelastic support conditions were introduced along the aortic wall and aortic root motion, estimated from the cardiac-gated CT data of a healthy subject, was enforced at the proximal boundary. The simulation was run for an input pressure ranging from 80-110mmHg. Volume compliance of the vessel as obtained by integrating the area compliance over the centerline length (both variable and invariable) was subsequently compared to the ground truth (which was imposed by the material stiffness).

**Results:** Integration of the area compliance over an invariable centerline length led to an underestimated average distensibility by -68%. After taking into account the elongation, the error was improved to -25% (Figure 1).

**Conclusion:** The elongation of the aorta during cardiac cycle was found to affect significantly the estimation of arterial compliance.

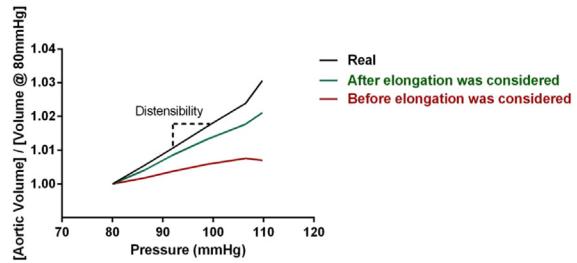


Figure 1. Relative volume, -normalized for the reference value at 80mmHg,- as a function of pressure during systole, calculated before and after considering the axial extension of the aorta.

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#### P47

#### ABNORMAL FLOW PATTERN IN MARFAN PATIENTS IS RELATED TO AORTIC GEOMETRIC FEATURES: A 4D FLOW MRI STUDY

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**Introduction:** Ascending aorta aneurysm and dissection are the most common cardiovascular complications affecting Marfan syndrome patients (MFS). Recent large increase in life expectancy of MFS driven the growing prevalence of descending aorta (DAo) dilation and dissection. Despite local abnormal vortices in the proximal DAo were related to local dilation, their origins have never been explored. We investigated the link between aortic geometrical characteristics and abnormal flow pattern in the thoracic aorta of MFS.

**Methods:** Fifty-tree MFS without significant aortic valve disease and forty age-matched healthy volunteers (HV) were prospectively included in 4D flow-MRI study, obtaining flow field and angiography. Spatial distribution of flow (in-plane rotational flow (IRF) and systolic flow reversal ratio (SFRR))